

Mechanical phenotyping of cells flowing through microfluidic constrictions

Magalie Faivre

Univ Lyon, CNRS, Ecole Centrale de Lyon, Université Claude Bernard Lyon 1, CPE Lyon, INL, UMR5270; Institut des Nanotechnologies de Lyon INL-UMR5270 CNRS, Université Lyon 1, 69622 Villeurbanne, France.

E-mail: magalie.faivre@univ-lyon1.fr

It is now well recognized that mechanical signature of cells can give information on their physio-pathological state. Here, we will illustrate this concept by two different microsystems able to provide the mechanical phenotype of human cells.

First, we know that the membrane of healthy Red Blood Cells (RBCs) possesses a unique structure responsible of their remarkable ability to deform to go through the small capillaries of the microcirculation. However, various diseases such as malaria [1], Sickle Cell Anemia [2] (SCA) or Hereditary Spherocytosis [3] (HS) are associated with impairment of this deformability. We propose to evaluate the possibility to identify mechanically impaired RBCs through their dynamical behaviour when flowing out a microfluidic constriction, hence providing a new type of diagnostic tool based on mechanical phenotyping of cells.

We also addressed the mechanics of more complex cells such as nucleated ones. In Acute myeloid leukemia (AML), a cancer of the myeloid line of blood cells, the abnormal proliferation of leukemia cells build up in the bone marrow and blood and interfere with normal blood cell production due to their inability to differentiate into mature cells. Recent findings - highlighting an increase of the mechanosensitive pathways in AML relapsed patients [4] - tend to imply a strong interconnection between the cell's mechanical properties and their ability to survive chemotherapy. We propose to use a passive microfluidic approach [5], quantifying the additional hydrodynamic resistance to the one of the geometric constriction in which they flow, to evaluate the possibility to predict the outcome of a therapeutic treatment using the mechanical signature of AML cell lines. This approach could be the first step towards the development of a new system for personalized medicine.

[1] J.M.A. Mauritz, T. Tiffert, R. Seear, F. Lautenschlager, A. Esposito, V.L. Lew, J. Guck and C.F. Kaminskia, J. Biomed. Opt., 2010, 15(3), 030517.

[2] J.L. Maciaszek and G. Lykotrafitis, J. Biomech., 2011, 44(4), 657-661.

[3] R.E. Waught and P. Agre, J Clin Invest., 1988, 81, 133-141.

[4] S. Lefort, unpublished results, 2022.

[5] M. Abkarian, M. Faivre, H.A. Stone, PNAS, 2006, 103, 538-542.

Bonjour à tous,

Nous voulions vous transmettre quelques infos de dernières minutes avant votre venue pour les journées du GDR MNF à Lyon lundi et mardi prochains.

Tout d'abord, pour ce qui est d